

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
<small>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.</small>				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 2-15-05	3. REPORT TYPE AND DATES COVERED Final		
4. TITLE AND SUBTITLE Uncertainties and Interdisciplinary Transfers through the End-to-End System (UNITES)		5. FUNDING NUMBERS N00014-01-1-0821		
6. AUTHOR(S) Robert N. Miller				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Oregon State University Corvallis, OR 97331		8. PERFORMING ORGANIZATION REPORT NUMBER N0150A		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) ONR		10. SPONSORING/MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Unlimited Public Access		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words)  <p>The PI is part of an interdisciplinary team, led by Allan Robinson and Phil Abbot, with expertise from the scientific to the Navy fleet application communities. The overall goals of this research were to define and characterize the variabilities and uncertainties in the components and linkages of the general physical-geo-acoustical system relevant to the support of naval operations, and transfer quantitatively the spatial-temporal environmental variabilities and uncertainties through the system, including coupled interactions, in order to determine uncertainty measures, sensitivities and feedbacks critical for operational predictions and parameters. The specific goal of this part of the project is to develop probabilistic models of transfer of uncertainties in the end-to-end system.</p>				
14. SUBJECT TERMS			15. NUMBER OF PAGES	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT	

## **Uncertainties and Interdisciplinary Transfers through the End-to-End System (UNITES)**

Robert N. Miller  
College of Oceanic and Atmospheric Sciences  
Oregon State University  
Oceanography Admin. Bldg. 104  
Corvallis, OR 97331-5503  
Phone: (541) 737-4555 Fax: (541) 737-2064 Email: [miller@coas.oregonstate.edu](mailto:miller@coas.oregonstate.edu)

Philip Abbot  
OASIS Inc.  
5 Militia Drive  
Lexington, MA 02421  
Phone: (781) 862-8339 Email: [Abbot@oasislex.com](mailto:Abbot@oasislex.com)

Allan Robinson  
Harvard University  
Division of Engineering & Applied Sciences  
Pierce Hall  
Cambridge, MA 02138  
Phone: 617-495-2819 Email: [Robinson@pacific.deas.harvard.edu](mailto:Robinson@pacific.deas.harvard.edu)

Award Number: N00014-01-1-0821

### **Final Technical Report**

The PI is part of an interdisciplinary team, led by Allan Robinson and Phil Abbot, with expertise from the scientific to the Navy fleet application communities. The overall goals of this research were to define and characterize the variabilities and uncertainties in the components and linkages of the general physical-geo-acoustical system relevant to the support of naval operations, and transfer quantitatively the spatial-temporal environmental variabilities and uncertainties through the system, including coupled interactions, in order to determine uncertainty measures, sensitivities and feedbacks critical for operational predictions and parameters. The specific goal of this part of the project is to develop probabilistic models of transfer of uncertainties in the end-to-end system.

The objective of this phase of the project was to characterize the transfer of uncertainties from the acoustic environment to the sonar and its signal processing in probabilistic terms. This involved construction, calibration and evaluation of uncertainty and variability models for the system and its components and developing generic methods for efficiently and simply characterizing, parameterizing, and

20050223 287

prioritizing variabilities in the end-to-end system (ETES) and uncertainties arising from regional scales and processes.

We applied a model ETES of modular design to investigate the combined effect of mesoscale structure and short-wavelength internal waves on acoustic transmission loss at low to moderate frequencies in the coastal environment. As a first guess, we view the internal wave field as being superimposed on the mesoscale field. Since these two fields can be expected to interact physically as well as acoustically, a proper simulation would account for exchange of energy, momentum and heat between the mesoscale field and the small-scale internal wave field. The modular design of our prototype ETES system allows us to make incremental but steady progress by increasing the complexity and level of detail represented in each component of the model.

The first version of our model ETES was implemented with the University of Miami Parabolic Equation Model (UMPE) to calculate transmission loss in the littoral environment, realizations of a random field of internal waves with the Garrett-Munk spectrum, and a variety of different realizations of the mesoscale field, the most advanced of which is the output of the Harvard Ocean Prediction System (HOPS).

In our study of uncertainty due to a random internal wave field, we found that some very small-scale features show differences of the order of 10db between the perturbed and unperturbed cases. The effect of the perturbation on the ray structure is particularly evident in shorter wavelength cases. The differences in the range-averaged transmission losses are smaller, typically a few db at 25Hz, but fields obtained by slightly different methods of range averaging can also differ by a few db.

---

---

---